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THE UNIVERSITY OF ALBERTA

Implementing PERT In A Volunteer Organization

by

© R.C. Edwards

A THESIS

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I. Introduction

This thesis describes the implementation of a planning and control system in a large volunteer organization. The system described is an interactive version of PERT, a Project Evaluation and Review Technique. The volunteer organization is the XI Commonwealth Games Foundation. The work involved analysing the Commonwealth Games Foundation, a large complex volunteer organization, and selecting the appropriate planning and control system for it. An attempt was made to avoid the pitfalls encountered by others referenced in the literature survey in Section II and to implement the planning and control system in a carefully thought out manner which considered the personnel and characteristics of the Commonwealth Games Foundation.

Problem Statement

The problem being addressed can be simply stated as: "to design and implement a planning and control system for the XI Commonwealth Games Foundation." After consideration of the project characteristics, requirements, and the available management tools, PERT was chosen as the technique to be used. PERT was the appropriate choice since the project involved non-repetitive processes and time-critical

scheduling problems.

Importance of this Project

This project is important for two reasons. It is of obvious importance to the XI Commonwealth Games Foundation since it provides the Commonwealth Games Foundation with a planning and control system with which to stage the Games. It is also important as a research project because techniques are developed which may be of value to other large volunteer organizations. This is a relatively unique application of PERT. At time of writing the overall success of the project is not known; however many of the benefits of planning have been realized in the initial phase of constructing the network.

Organization of Remainder of Thesis

Section II includes a review of the literature on planning and control systems, and is followed by a discussion of the XI Commonwealth Games Foundation organization in Section III. Section IV is concerned with the implementation of the planning and control system. For reasons of exposition Section IV explains both the research design and the conduct of the research. We will describe the general theoretical approach to PERT implementation followed by a specific discussion of what was actually done on this project. The method is basically that suggested by Law and

Lach[1] , but with certain modifications considered necessary due to the peculiarities of the Commonwealth Games Foundation and local conditions. Section V presents the results of the project.

Terms

The following terms are used throughout the thesis:

- CPM: Critical Path Method
- GAMEPLAN: the acronym used to refer to the planning and control system developed for the Commonwealth Games Foundation
- Games: the XI Commonwealth Games
- MIS: Management Information System
- PERT: Project Evaluation and Control Technique
- OR: Operations Research
- MINIPERT: an interactive PERT program developed by IBM

II. Literature Survey

The literature suggests that most, if not all, planning and control systems have been oversold, misunderstood, abused, and fallen into disfavor by many organizations that could profit from their use.

The value of planning and control systems will be discussed only briefly. Attention is paid instead to the pitfalls described by various researchers. In reviewing the literature on planning and control systems it is necessary to consult works on Operations Research(OR), Management Information Systems(MIS), Critical Path Method(CPM), Program Evaluation and Review Technique(PERT), networking, and systems design.

Battersby[2] in his book "Network Analysis for Planning and Scheduling" suggests the main value of network construction lies in its properties of forced planning, monitoring and control of difficult projects. A significant added advantage of a "feed-forward" mechanism is also attributed to networking in that it is possible to estimate the consequences of an action before actually taking that action. This forward-looking facility tends to replace crises management with anticipatory action, thereby resolving bottlenecks before they occur.

Battersby attributes the following specific advantages

to PERT:

1. it forces a thorough pre-planning of the task;
2. it increases coordination;
3. it identifies trouble spots, often in advance, and pinpoints responsibility;
4. it refines thinking and increases user's awareness of the problems involved, and their relative importance in the overall operation;
5. it focuses management's attention on to those activities which are, or are likely to be, in difficulties, rather than on to activities which are progressing smoothly and hence need no attention;
6. it facilitates the hand-over of information during changes in management and is a valuable aid when issuing orders;
7. it indicates optimum start and finish times for each activity in an operation;
8. it enables the plan to be revised in the best way to suit changed circumstance;
9. it suggests where alternative methods should be sought;
10. it allows progress reporting and the issue of orders ... without complete loss of security;
11. it allows certain operations that follow a set pattern to be partly pre-planned, so speeding up the final planning;
12. it is an important means of training personnel in the techniques of handling operations;

13. it forms a useful, comprehensive record which requires a minimum of storage space.

In the early 1960s, CPM was heralded as the answer to construction planning and control problems. In 1962 the Engineering News Record included an editorial entitled "CPM and Survival[3]." It suggested that the use of CPM would be "necessary for survival" in the future. A survey of CPM use by contractors entitled "CPM Surveyed"[4] was published in the Building Construction journal in 1965 and predicted "that in the near future CPM will become a necessity for any successful contractor."

Davis[5], in his paper "CPM Use In 400 Top Construction Firms", published in 1974, reviews the successes and failures of a large sample of firms using CPM. His findings show that: (1) not all large construction companies use network methods, (2) the most common use is for planning rather than for control. (3) only a few feel that they have realized all of the potential benefits of networks.

Davis surveyed 340 of the top 400 construction firms in the United States of America based on construction volume in 1970. He received 235 responses which were approximately equally distributed by type of firm and volume of business among the top 400. He found that 190 (ie 80%) of the 235 firms were using some form of CPM. He also found that 90% used CPM for detailed planning whereas only 52% used it for control purposes.

Davis found that 89% used CPM information at the project management level and 40% stated that top management used it. He also found that 79% cited improved planning, 76% cited improved project control, but only 16% cited cost savings as the major benefits of CPM.

The most commonly cited top management concerns about CPM were that 53% felt the construction personnel were not really using it, 44% felt CPM required excessive work to implement, and 24% felt CPM was too dependent on specialists to implement. When asked how important CPM was to their success 22% felt it was very important now and 32% felt it would be very important in the future.

Davis attempted to determine if there were any differences among firms who were successfully using CPM and the type of application they were using it on. He found that 61% considered themselves moderately successful at achieving the benefits attributable to CPM, 15% very successfully, and 16% unsuccessful. He found that twice as many very successful users employ CPM for control purposes as do the unsuccessful users. Also, all the very successful users indicated use of CPM information at the project management level compared to only 60% of the unsuccessful users. Also 70% of the very successful users claimed top management use of CPM information compared to only 17% of the unsuccessful users. Also, 74% of the very successful users claimed they make frequent decisions based on CPM information whereas only 3% of the unsuccessful CPM users made that claim.

Davis' survey suggested that successful use of CPM depends on top management's continued support.

Davis also investigated top management's reasons for unsuccessful use of CPM. His findings show that 67% of the unsuccessful users attribute lack of support from people using CPM, 30% claim lack of top management support, while 23% cite poor training of personnel as the reasons for failure.

Davis determines that the firms which are using CPM successfully are characterized by a high degree of top management support. He further notes that successful users of CPM cite good top management support, with good support from people using the system and good training of personnel as the reasons for their success. Law and Lach[1], in their paper "Implementing the Critical Path Method in a Large Organization" maintain that successful CPM implementation requires management briefing and staff training. Battersby[2], in "Network Analysis" notes extensive training as well as board of director's support as an essential ingredient for a successful network implementation.

Huysmans[6], in his book "The Implementation of Operations Research" reports several examples of successful OR implementation. Vazsonyi's[7] article "OR in Production Control" cites success of OR in production control due to management's ready acceptance of OR as an extention of their thinking. McKinsey's[8] article "A Limited Survey of Industrial Progress in OR" relates the success of OR in oil

refining due to OR being accepted as a logical extention of refinery engineers' analytic calculations and therefore finding a sympathetic and understanding management. Ackoff's[9] article "Unsuccessful Case Studies and Why" notes the importance of a stable management at Case with a serious interest in OR. Weldon[12] emphasizes the need to sell management in OR techniques in his paper "Cargo Containerization in the West Coast Hawaiian Trade." Law and Lach[1] emphasized comprehensive training for CPM project staff and selling top management via the successful planning and execution of a suitable pilot project.

All the above references point to the need for top management support and committment to the planning and control systems project. Axelrod's[11] "Rules for Building an MIS" emphasizes the need to get top management involved and traces most MIS problems to insufficient top management involvement. Murdick and Ross[12], in their paper "Management Information Systems: Training for Businessmen" found that managers had a most pressing need for MIS training.

The literature in MIS and planning and control systems point to the need to get top management involved in order to improve the chances for a successful implementation of these management tools. These similar findings in the literature are not surprising when you consider that a planning and control system is a type of MIS.

III. The XI Commonwealth Games Foundation

Background

The XI Commonwealth Games Canada (1978) Foundation was officially registered under the Companies Act in December 1975. However, the Commonwealth Games Foundation had its unofficial beginning in 1970 when Edmonton decided to make a serious bid to host the 1978 Games. The Commonwealth Games Foundation's development over time into a formal organization is itself a matter worthy of a thesis in organization theory. In this thesis we merely examine and describe the Commonwealth Games Foundation organization as it relates to the implementation of PERT.

The XI Commonwealth Games Canada (1978) Foundation worked with the Commonwealth Games Association of Canada to bid for the 1978 Games. This bid included a film highlighting Edmonton's suitability to host the Games and a presentation by the Mayor of Edmonton. It took place in 1972, six years prior to the 1978 Games, and was made to the Commonwealth Games Federation. The Commonwealth Games Federation is the ultimate Games authority and has the responsibility for awarding the Games. Edmonton was chosen as the site for the 1978 Games and began the process of forming the organization to stage the Games which involved competitions in 11 different sports at 10 different venues.

This organization officially became the XI Commonwealth Games Canada (1978) Foundation with responsibility for staging the the 1978 Games.

Organization Structure

The Commonwealth Games Foundation as it exists today contains approximately 800 volunteers and 50 paid staff. The Commonwealth Games Foundation is primarily a volunteer organization. Paid staff exist to support the volunteers. The volunteers and paid staff hold important managerial as well as non-managerial positions. The paid staff is expected to expand to 150 positions by August 1978 whereas the number of volunteers are projected to reach 2000. Volunteers perform full-time, part-time, and occasional jobs.

The organization chart (see appendix 1), from the top down, shows an organization composed of a President and five Vice Presidents. The President has reporting to him, or is in liaison with, nine committees or external organizations. The Executive Committee, composed of the President, five Vice Presidents, Secretary, and Treasurer, is the policy formulation body. Each Vice President has three or four operating divisions reporting to him. The total number of divisions is seventeen. Each division is headed by a Chairman. The Division Chairman in most divisions works closely with a Division Manager or Division Coordinator. Each division has several committees, headed by Committee Chairmen, which number over 100 in total. All the Vice

Presidents, Division Chairmen, and Committee Chairmen are volunteers. The Administration Manager and headquarters staff reports to the executive committee through the Administration Manager. Paid staff comprise most of this group. Also, all the Division Managers and Coordinators are paid staff.

The Role of the Volunteer

A consciencious effort has been made to utilize volunteers as much as possible throughout the organization. The reasons for doing this are to keep costs down and to increase community commitment and involvement. Perhaps the most interesting aspect of the management of the Commonwealth Games Foundation relates to the role of volunteers. Volunteers occupy the important policy-making positions of Vice Presidents and Division Chairmen as well as the important operational positions such as Committee Chairmen.

Although the volunteer effort is essential to the staging of the Games, it also adds a new dimension to the management of the Commonwealth Games Foundation. Many of the volunteers hold permanent jobs in industry and work on the Games in their spare time. As a result they are not as available as paid staff. A project requiring four hours effort may take two weeks to complete in a volunteer's spare time. Control, communication, discipline, and motivation of volunteers is difficult, particularly by a paid manager. The

manager, because of his daily involvement, is more attuned to the pressures in the Commonwealth Games Foundation. As a result a difference of opinion can occur between a volunteer and a manager concerning the urgency of a project. Since the manager exists to assist the volunteer, he finds himself in the precarious position of having to react to pressures from his superiors while he lacks the authority and means to apply pressure to his volunteers. Resentments can occur because the manager is paid but the volunteer is not.

How can a person who is so highly motivated to accept a volunteer position be further motivated to do more work, to plan better, to expend more of his spare time? A reasonable presumption might be that involvement in preparing a plan, especially one that benefits the volunteer as well as others by highlighting interdependencies among divisions, might produce sufficient commitment to that plan to conscienciously carry it out. This personal involvement in preparation of a PERT network is considered essential to its success and is refered to again in Section IV under the heading Network Construction.

Terms of Reference

The Commonwealth Games Foundation has the responsibility to stage the Games. In practice this means organizing and carrying out all the activities, including operating the facilities, necessary to ensure the successful

operation of the Games between August 3 and August 11, 1978. The City of Edmonton has the responsibility for acquiring equipment, constructing facilities, and suitably modifying existing facilities. This division of responsibilities is outlined in an official agreement between the Commonwealth Games Foundation and the City of Edmonton dated March 24,1974.

In practice it is not possible to "cleanly" divide these responsibilities. Although the City agreed to acquire equipment and construct facilities, it had to rely on the Commonwealth Games Foundation for technical specifications. Although the Commonwealth Games Foundation had responsibility for operating facilities, it had to rely on the City to provide support services such as parks maintenance. In practice therefore, very close cooperation was essential and a Management Advisory Committee, with representatives from the Commonwealth Games Foundation and City, was set up to coordinate programs. In this thesis an uncomplicated approach will be taken and the Commonwealth Games Foundation's terms of reference will be considered as simply staging the Games.

Staging the Games

Anyone who watches the 1978 Games will eventually marvel about the logistics involved in planning and staging such a complex event. It is staggering to try to comprehend the massive planning and coordination necessary just to organize for the personal needs of the athletes. Approximately 2000 athletes are expected and each will require accomodation, transportation, and food, as well as access to practice fields and medical attention. Similar provisions and many special services are necessary for officials and media, as well as VIPs. These are the obvious requirements which most people are aware of. It is also necessary to provide sports facilities and equipment that meets Games standards, to organize ceremonies, to assemble staff and volunteers, to sell tickets, to set up communications facilities, to raise funds, to accredit all athletes, officials, and employees, as well as stage the actual athletic competitions.

It was estimated that approximately five thousand major activities would be identified and performed prior to the Games. Planning and coordinating that many activities among seventeen operating divisions, one hundred committees, 150 staff, 2000 volunteers, over several months, and at various locations would be an impossible management problem without

a planning and control system. Considering that the start dates, or durations, or other aspects of most of those activities would change in some manner over the time period merely complicates the management problem. As the project becomes better defined, some activities are dropped, others are added, and the logic is revised. This was recognized by the Commonwealth Games Foundation management and a consultant was hired to determine a critical path and construct a bar-chart based planning and control system. This was done in 1974. However it did not have any updating facility and gradually became hopelessly out of date. It was extremely useful however because its construction required a thorough planning of activities throughout the Commonwealth Games Foundation and among divisions. The realization that it was badly out of date led to a desire to update the bar-chart in 1977. However, the limitations of this static approach were realized and instead a planning and control system with updating facilities was authorized by the executive committee. An interactive PERT system with updating facilities was eventually settled on and is described in detail in Sections IV and V of this thesis.

Operating Authority

As mentioned previously, the Executive Committee is the primary policy-making body. However, the Division Chairman and Division Manager play a role in this process as well by making specific policy recommendations to the Executive Committee through their Vice President. In a general sense the Vice President and Division Chairman can be thought of as policy makers and facilitators whereas the Division Manager is more concerned with daily operations, including carrying out the plans of his Vice President and Division Chairman. The Vice President and Division Chairman also plays the role of community watchdog over the Games ensuring that public funds are used properly. As a result the Division Manager's authority is restricted to his specific terms of reference and approved budget. He must seek the approval of his Division Chairman for major expenditures and any unbudgeted expenditures. Approval can be delayed if the Division Chairman decides the expenditure exceeds his authority and refers it to his Vice President. It is further delayed if it goes to the Executive Committee for decision. As a result it is essential that proper plans and budgets are prepared in order to maintain operating efficiency. As the Games approach it is anticipated that approval delays will not be tolerable and the Division Manager will of neccessity be given more operating authority.

Sports Oriented Activities

Although the Commonwealth Games Foundation is organized around seventeen operating divisions, there is a trend toward a sports-oriented organization. In fact several sports committees have been structured with responsibility for coordinating all activities related to a specific sport. The reason for this is that during the planning stage, activities tend to be functionally oriented. For example, the Transportation Division must plan to transport all athletes, all officials, all employees regardless of the sport they are participating in. However, as the Games approach, the delivery system for transportation services within the framework imposed by various sports must be worked out. Thus, it becomes necessary to plan the delivery of transportation services to specific locations, at specific times, even though the transportation fleet may remain centralized. The same is true of Media Services. General planning can take place on a rather isolated basis, but the provision of media services to specific locations must be coordinated with the delivery of the services of other divisions involved at that location. This trend necessitated a flexible planning and control system capable of producing reports relevant to the activities of a specific division as well as producing reports of all

activities relevant to a specific sport, regardless of which division the activities originated in. This approach is similar to matrix management since it utilizes the expertise of people from the whole organization, regardless of their location in the functional organization, to work on specific projects.

Meetings

Meetings were used at all levels of the Commonwealth Games Foundation and were an important source of information. The Executive Committee meeting, which included the President, Vice Presidents, Secretary, Treasurer, and Administration Manager, was essentially a policy level meeting. However, the Executive Committee regularly received progress report presentations from selected Division Chairmen or Division Managers. These meetings were also used to resolve 'crises' which occured from time to time.

Several other meetings were regularly held which could be classified as coordination and information meetings. These included a Managers' Meeting, attended by Division Managers, where brief progress reports were made and some conflicts resolved. Divisions also held meetings among division staff and volunteers. There were frequent committee meetings and numerous one-on-one meetings where one Division Manager would meet with another Division Manager to get information or resolve problems. Meetings were an important

source of general information. They were primarily used as progress reporting sessions rather than planning sessions.

IV. Implementation

This section describes the various steps in the preparation and planning, selection of a pilot network, organization and training, systems design, and network construction, which should result in the effective implementation of PERT. As discussed in Section II the failure of PERT projects often can be attributed to the lack of commitment by top management. This can often be traced to a lack of understanding or to misunderstanding. A major component of the implementation plan must therefore be the education of all the network users, particularly top management. This education phase involves indoctrinating top management in the potential benefits of PERT.

Preparation

Before implementation of a PERT network can begin, a certain amount of preparation should be done. Preparation involves reviewing the literature on planning and control systems and PERT in particular. The objective here is not to learn about planning and control systems but to review the experiences of researchers paying particular attention to the pitfalls that they have experienced.

Another aspect of preparation involves gaining an

understanding of the organization. This was done in GAMEPLAN (the planning and control system for the Commonwealth Games Foundation) by reviewing terms of reference and history, organization charts, and through preliminary orientation sessions with key staff. The objective is to immerse oneself in the organization to understand its purposes, lines of authority, decision-making processes, social processes, politics and objectives.

Briefing Management

If management is not convinced that a planning and control system is desirable, Law and Lach[1] suggest chances for successful implementation are negligible. Management should therefore be consulted about planning and control system advantages.

With GAMEPLAN management briefing took several forms. Top management was financially committed to a planning and control system through budget provisions made previously. The Vice Presidents and President had been convinced of the need to update a previous planning and control system that was two years out of date. The difference between GAMEPLAN and other planning and control systems considered was its dynamic updating capability which was instrumental in its selection as the planning and control system for the Commonwealth Games Foundation.

Top management was given a presentation on GAMEPLAN.

This involved a short film on CPM and a discussion specifically relating it to the Games. The film was titled "Critical Path" and was produced by Richard Costain Limited[13]. It depicts the use of CPM in the construction of a service station. Arrow diagrams are illustrated and the concepts of float, critical events, early start, and late finish are discussed in simple terms, and are easily understood. The following advantages were discussed:

(1) GAMEPLAN would provide an easily understood verbal and visual picture of the project;

(2) GAMEPLAN would highlight bottlenecks;

(3) GAMEPLAN would provide a tool for simulating alternative strategies.

It was also emphasized that GAMEPLAN could not replace managerial decision making but merely provide information to assist the decision maker. The role of the computer was de-emphasized so as not to confuse the issue.

In the discussion that followed it was apparent that most of the top management was enthusiastic and committed to a planning and control system. Similar briefings were held with Division Managers, Division Chairmen and various Committee Chairmen and committees. An open invitation to repeat the presentation to any interested group was made. Throughout these briefings it became clear that most of the managerial people recognized the need for a planning and control system and none were openly opposed to GAMEPLAN. The most frequent concern expressed was the amount of work

required to implement GAMEPLAN.

Interviews

Personal interviews with managerial staff were also conducted. The purpose of these interviews was threefold:

(1) To gain a more thorough understanding of the functioning of the Commonwealth Games Foundation;

(2) To determine specific information requirements;

(3) To further promote and sell GAMEPLAN.

A typical interview took about one hour for the actual interview and about one hour of preparation related to studying division terms of reference and general division orientation. Normally the interview began with an explanation of the projects objectives and progress to date, as well as the interviewer's role in the project. This was followed by specific questions designed to elicit answers which would improve the interviewer's understanding of the Commonwealth Games Foundation functioning. In this phase questions relating to existing information systems, financial authority, the role of volunteers and paid staff, and other questions were asked.

From this phase it became clear that the paid staff worked for the volunteers and that the volunteer Division Chairmen and Vice Presidents retained the financial authority. This is primarily out of fear of cost overruns like those that occurred in the Montreal Olympics. It also

was learned that meetings were the primary source of information exchange.

The next phase of the interview involved determining information requirements. Questions were asked relating to what types of information was required, at what frequencies, and by whom.

The majority expressed concern about having to depend on other divisions for several services but not having access to progress reports on the other divisions' activities. The main concern therefore related to activities being performed by one division for another division. These activities are referred to as interface activities. Also the concensus was that the reporting system should be designed for the Division Manager and Division Chairman's needs since they were responsible for daily operations. The primary information generally required seemed to be reports of late activities and reports of activities due to be completed in the next 30 days.

The last phase of the interviews involved describing how a planning and control system would benefit the Commonwealth Games Foundation and the interviewed person's division specifically. Attempts were made to show how a planning and control system could satisfy their information requirements as well as benefit them in planning and control. This phase was difficult because a specific planning and control system could not be used as an example without appearing to have already made the choice. As a

result the acronym GAMEPLAN was used to refer to some hypothetical interactive planning and control system that could be dynamically updated and that would produce reports of activities tailored to a specific division or sport. Another aspect of these interviews was to lay the groundwork for the networkers who would eventually draw the network.

Interviews were held with all 11 of the Division Managers. Although 17 divisions existed only 11 had a full-time paid manager. Only 12 of the 17 Division Chairmen were interviewed because 5 Division Chairmen opted out of the interview in favor of letting their Division Manager handle it completely. Only 4 of the 5 Vice Presidents were interviewed as 1 Vice President could not find the time. In addition the President, Administration Manager, and Host Broadcaster were interviewed. In total 32 out of 37 potential interviews were conducted with top management.

These personal interviews with the Vice Presidents, Division Chairmen, and Division Managers confirmed that although the majority supported GAMEPLAN, some were indifferent and some were opposed. Of the 32 interviewed, 24 were in favor of and recognized the need for a planning and control system, 2 were indifferent, and 6 felt it was not necessary. Six of the 11 Division Managers, all of the Vice Presidents, and 10 of the 13 Division Chairmen were in favor of a planning and control system. Those in favor usually mentioned the need to get access to information from other divisions, and the need to coordinate interface activities,

that is activities affecting more than one division, as the main reasons for needing a planning and control system. However, several also mentioned the need to do detailed planning and get activities on a schedule as important reasons. The indifferent persons could not see significant benefits compared to their existing decision, planning, and control system and were reluctant to repeat what they considered to be another fruitless exercise similar to the previous planning and control system. Those who were opposed generally cited "too much work" for "too little personal benefit" as their concern and also felt they were getting along fine and didn't need any additional reports. There also appeared to be some fear of loss of autonomy in some cases.

During these interviews insight was gained about the functioning of the Commonwealth Games Foundation. Existing information systems were explored and the specific information needs of each individual were determined. Everyone interviewed agreed that GAMEPLAN should be designed with the primary objective of serving the needs of the Division Managers and Division Chairmen and of highlighting the interdependencies amcung divisions. The Vice Presidents' managerial styles tended to be "management by exception" and they seemed prepared to rely on the Division Managers or Division Chairmen to keep them informed. As a result they felt their own information needs should be subordinated. In fact, this result would normally be anticipated at the

policy-making level. However, the Vice Presidents did request the capability to receive a report of all the information if they so desired and also to have a regularly produced overview or "big picture" of the progress.

Another result of the interviews was the realization that there was a definite need to know the progress of all activities related to a specific sport. As the Games approach there would be an orientation away from a functional organization to a sports-oriented organization. In fact, that change had already begun with the formation of a few sports committees which would apparently have responsibility for coordinating all the activities related to a specific sport regardless of which division the activity originated from. The sports committee would have representatives seconded from various divisions as required. Fourteen of the 32 top managers interviewed agreed that a sports orientation was inevitable for their divisions and everyone agreed that at least some of the divisions were sports oriented. In fact 6 of the divisions professed to be sports oriented.

These interviews also reinforced the need to dynamically update GAMEPLAN. The concensus was that as the Games approached the time span for many activities would shorten and interdependencies would become more important. Therefore, seemingly insignificant deviations from one division's plan could significantly impact another division. All those who agreed that a planning and control system was

needed also agreed that one of its characteristics must be the capability to be updated frequently and easily.

Programmed Learning

Another way to further managerial acceptance of a planning and control system through improved understanding is by utilizing a programmed learning text. The basic philosophy followed was to completely answer any question by anyone. Thus, for those managers with a desire to learn more about PERT, a programmed learning text was available called "PERT Fundamentals[14]" and was used by a few people to brush up or clarify details which they missed during the film or discussions. The opportunity to learn at one's own pace is a strengh of this learning technique.

Systems Design

The systems design phase is concerned with determining what information must go into the system so that the required information can come out. The intervening process is commonly referred to as information processing.

Determination of the output information required careful consideration of everything the designer had learned about the organization through his independent study of available information and from his discussions with managerial staff. Taking into account the expressed

information needs at the various levels of the organization, he must then specify the frequency, format and distribution of reports to be generated. In GAMEPLAN it was decided that a few simple and clear reports at regular intervals would suffice. However, the need for reports on demand was recognized and was provided for in the system design. These reports are discussed in more detail in Section V.

In addition it was obvious that frequent and easy updating facilities had to be provided in order to facilitate acceptance and use of GAMEPLAN. Due to the organization being structured into seventeen major operating divisions and several other units it was neccessary to be able to produce reports tailored to a specific division's activities only. This requirement led to the sub-net approach where each division was essentially treated as a separate network, but was connected to other divisions by interface events. Another requirement was to produce a report encompassing all activities related to a specific sport regardless of which division or divisions were responsible for carrying out the specific activities.

Having determined the output information required, the specification of input information and the process by which it gets into the system was next. It involved locating the right person with the authority to provide the information required and then setting up a regular procedure for updates. The characteristics of the Commonwealth Games Foundation and the nature of the project involving the

staging of the Games required a network type information processor. The nature of the output specifications led to acquisition of an IBM program product called APL MINIPERT, which provides dynamic updating and modification of report formats. The ability to print the reports instantly right at the terminal or on a delayed basis on a remote printer was particularly useful. The facility to produce division reports and sports reports was essential.

Pilot Network

A suitable pilot project is usually considered necessary to help sell a planning and control system. It is desirable that the pilot project be undertaken as soon as possible so that results can be available early to assist in the selling of the planning and control system. The pilot project should be as close to the real thing as possible but not so complex so as to endanger its successful implementation. A trivial project however, may not reveal the full potential of the planning and control system.

The Accreditation Division is responsible for providing regulatory control of athletes, officials, employees, VIPs, and other authorized persons. The purpose of accreditation is to allow authorized persons access to the facilities they have a need to access, and to deny access to unauthorized persons.

With GAMEPLAN the Accreditation network was chosen for

the pilot network because of its advanced planning stage and because its planning and control method was similar to that used by GAMEPLAN. The early appearance of the Accreditation network reports, representing 365 activities, was considered essential in furthering managerial acceptance of GAMEPLAN.

Personnel and Training

The personnel required for network construction were three full-time persons. These were two summer students, hired by the Commonwealth Games Foundation for this project, and one person already on staff. These three persons had access to professional advice of a consultant whenever it was needed.

The use of students and in-house staff was done for several reasons. The summer period, May to September, was the amount of time required to construct the base network. The students were graduate engineers who had already received instruction in network techniques and computer systems. The use of students and the in-house person avoided the pitfall of relying on an outsider to perform the planning function. Outsiders normally do not have access to all the information necessary to plan effectively. When an outsider is relied on to plan, employees tend to avoid the planning function, assuming it will be done for them. In fact all an outsider can do is to assist employees to plan by providing technical guidance on the use of available

management tools. Since the students and in-house person were 'on the regular payroll' it reinforced the attitude that this project was a Commomwealth Games Foundation activity and not the project of an outsider. Commonwealth Games Foundation employees were therefore working with other employees to construct their own activity networks. This approach was expected to increase cooperation and commitment to the project.

Network Construction

Network construction refers to the time-consuming, arduous task of eliciting lists of activities from the key persons responsible for performing the project. This is both an art and a science. It requires inter-personal skills and communication to get and keep cooperation. It also requires a rigorous adherence to a prescribed network construction procedure. Literature is available which describes the techniques used; therefore, these will not be discussed in detail here.

Initially, GAMEPLAN used the approach outlined by Law and Lach[1]. This method was modified in followup interviews in order to use time and manpower resouces as effectively as possible. A team of three persons interviewed each Division Manager. After a general review of the division's tasks by the manager, the first networker prepared a very general network. The second networker then copied the network to

paper. Usually the network is constructed by working backwards from the end of the project to the beginning. The Division Manager is asked "What previous event must have occurred before this event can be reached." This diagram need not be neat and perfect. It is merely intended to ensure that all persons present have the same general idea of the scope of the project and the broad breakdown of the work, that the general precedence of events is agreed on, and to point out any serious problems or omissions.

The next step is preparation of a detailed network. This requires adherence to a rigorous procedure for drawing the arrow diagram. One networker and the manager sit on one side of the table, opposite the task supervisor (that is the person responsible for carrying out the project). The networker and manager carefully elicit the plan from the task supervisor. In theory the task supervisor is best able to decide how the task should be carried out and therefore the detailed plan should be his plan if he is going to feel committed to it. The second networker sits next to the task supervisor and draws the arrow diagram. In this arrangement the arrow diagram is accurately drawn by the networker and rechecked by the task supervisor.

Activity titles are written on the diagram but no activity or node numbers. After the detailed diagram is checked for logical sequences, a master diagram is prepared. This is just a copy of the detailed diagram but is a neater and more legible version. At this point the master diagram

was given to the Division Manager for his approval and the approval of the Division Chairman and Vice President if necessary. Precise details on how to construct networks are available, with drawing conventions and materials required, in Battersby[2].

Activity Lists

After approval of the master diagram is obtained, then the activity lists can be prepared. The activity lists included the following information:

1. predecessor node number
2. successor node number
3. activity duration
4. scheduled date
5. sport code
6. activity description

The following is an example of an activity taken from the Tickets and Accomodation Division:

I345,I350,5.00,08/15/77,12 Update venue seating

This activity involves updating the venue seating by August 15,1977 and is estimated to take 5.00 days to accomplish. The activity number is I345,I350.

When an activity list was completed for an entire network it was sent to the University for on-line data entry into disk files on the University computer. Inconsistencies

and errors became apparent as soon as the network activity files were processed by the MINIPERT program. Inconsistencies, for example in the logical order of activities, were immediately brought to the attention of the appropriate authority for resolution. The activity files were then updated. Through an iterative procedure of processing the activity files through the MINIPERT program and then correcting errors, the activity files were eventually brought to a stable condition. Once the activity files were stable GAMEPLAN could produce meaningful reports.

Each division network was treated as a separate sub-net by the MINIPERT program. For example, the letter A was chosen to denote Accreditation activities. Activities were numbered in logical ascending order in increments of five to allow for later insertions. The first activity would therefore be numbered A1,A5.

Interface activities; that is, activities beginning in one sub-net and ending in another sub-net, had a slightly different numbering convention. For example, the code for the Transportation Division was T. The Accreditation Division had an activity to supply Transportation with a list of accredited VIPs. The numbering that would be used would be of the form: A60,AT100.

The codes, 00-12, inserted in the description indicated which sport the activity related to. The complete set of codes follows:

CODE	SPORT
00	Opening ceremony
01	Athletics
02	Badminton
03	Bowls
04	Boxing
05	Cycling
06	Gymnastics
07	Shooting
08	Swimming
09	Weightlifting
10	Wrestling
11	Lacrosse
12	Not sport specific

Updating

The method used to update the activity files after they reached a stable condition was quite simple. Division Managers or Division Chairmen would mark changes on their reports. The report therefore became a turnaround document for updating. These changes were submitted to the GAMEPLAN coordinator who was responsible for updating the activity file.

This method of updating was chosen for several reasons. It was simple and minimized the number of forms required. It

eliminated transcription errors which would have been inevitable if an intermediate update form was used. Also, it minimized the effort required to update the network since the updater merely had to change the erroneous data and was not concerned with copying other data onto another form.

Computer Equipment

GAMEPLAN utilized the time sharing services of the University of Alberta Department of Computing Services' Amdahl 470V/6 computer. This computer uses MTS (Michigan Terminal System), which is a time sharing operating system. The University specially acquired the IBM program product APL-MINIPERT for the Commonwealth Games Foundation to use. The only equipment on site was a DECWRITER II terminal situated at the Commonwealth Games Foundation administration offices. It was located in the administration offices in order to provide instant access by the network coordinator to the network reports and to ensure turnaround in a few hours. The DECWRITER was selected due to a need for a reliable, relatively quick printing terminal that supported the APL character set.

V. Results

Reports

GAMEPLAN was capable of producing fifteen standard reports and fifteen barcharts in its initial version when received from IBM. After modification to provide reports of activities specific to one sport, it was capable of producing an additional thirty reports. However, the need to keep reports simple and usable without overwhelming the user with mountains of information was considered of utmost importance. It did not seem worthwhile to produce the complete set of reports since most users would not find the time to use them all. It was also feared that if too many reports were produced, none would be fully understood and therefore none would be used. As a result, only four reports were made available on a regular basis, however any of the other reports could be produced if requested.

Available Reports

The following fifteen reports were available either in standard report format (that is activity lists sorted in different ways), or in barchart format:

1. sorted by order of input

2. sorted by predecessor
3. sorted by successor
4. sorted by duration
5. sorted by early start
6. sorted by early finish
7. sorted by late start
8. sorted by late finish
9. sorted by first three critical slacks
10. activities now in progress
11. activities to fall due in next 30 days
12. activities that should have been completed by today
13. sorted by description selection
14. sorted by predecessor-successor

These reports pertained to one specific division. Therefore, they contained only those activities of interest to that specific division.

Regular Reports

The concensus of opinion amoung top management was that simple, brief reports of activities falling due in the next thirty days (report 11) and of late activities (report 12) were all that was required on a regular basis. However, it was considered necessary to produce these two reports by division as well as by sport. The facility to accomodate the sport specific reports was developed by the University of

Alberta, Computing Services Department. This facility relied on the numeric code, 00-12, contained in the activity description, to determine which sport the activity related to. As a result the following four reports were available on a regular basis:

1. reports of late activities by division
2. reports of activities due in the next 30 days by division
3. reports of late activities by sport
4. reports of activities due in the next 30 days by sport

Samples of these reports are reproduced in Appendix 2 from the Tickets and Accomodation Division.

These two division reports allowed the Division Manager and Division Chairman to focus their attention on activities which were late, and therefore needed their attention, as well as allowing them to monitor progress of upcoming activities. The two sport reports gave the sports committees the opportunity to concentrate on late activities and upcoming activities related to their specific sport. They were not burdened with reports of irrelevant activities, nor with reports of activities that were on schedule and therefore did not require their attention.

Reporting Cycle

The updating process involves substantial discussions between the network coordinator and the Division Manager and then revision of the network. This occurs for all divisions on a staggered basis and takes about one month to complete the cycle. The reporting cycle is expected to shorten as the Games approach out of necessity and because the reporting system should function more smoothly with experience.

Summary

The objective of this thesis is to describe the actual process of designing and implementing a planning and control system in a large volunteer organization. The author's experience in working on such a project for the XI Commonwealth Games (1978) Edmonton Foundation is used to illustrate the various concepts discussed.

The design phase required a systems approach to the analysis of the Commonwealth Games Foundation organization and determination of the characteristics of the planning and control system needed. This was primarily accomplished through interviews with top management. This analysis led to the adoption of IBM's APL-MINIPERT program as the management tool on which the planning and control system is based. The

planning and control system eventually was dubbed GAMEPLAN for convenience in communication when referring to the planning and control system project.

The implementation phase required several steps. Emphasis was placed on achieving top management support for the project by enhancing their understanding and acceptance of the planning and control system. This was done by utilizing management briefings, films, programmed learning texts, interviews, and by the early construction and display of a pilot network. Also, Commonwealth Games Foundation employees were trained in network construction techniques and became the GAMEPLAN coordinators.

Conclusions

GAMEPLAN achieved many of the benefits attributed to planning and control systems. The GAMEPLAN reports provided easily understood verbal and visual pictures of the project. It highlighted bottlenecks and allowed alternative strategies to be simulated. The reports were the most tangible product of GAMEPLAN, however, considerable benefit was derived from the planning process that had to be undertaken long before any reports were produced.

In terms of the advantages Battersby attributes to PERT:

1. GAMEPLAN forced a thorough preplanning of each activity undertaken. For each activity a predecessor and

successor event had to be specified. Also the duration of each activity, its targeted completion date, and a meaningful description had to be written.

2. GAMEPLAN increased coordination at all levels of the Commonwealth Games Foundation organization. Whereas previously verbal progress reports were relied on extensively, with GAMEPLAN documented progress reports were available.
3. GAMEPLAN identified bottlenecks and trouble spots, often before the actual networks were available. Inconsistencies in the logical order of activities were quickly highlighted and could be resolved before any damage was done.
4. GAMEPLAN highlighted those areas of interdependency where one division was depending on another division for specific information or services. It helped place all the division's activities into perspective in terms of the overall organization.
5. GAMEPLAN emphasized problem areas and de-emphasized smoothly functioning activities. It focused management's attention on those activities which required their attention through the report of late activities.
6. GAMEPLAN provided detailed written documentation of activities and hence aided the transition problems caused by employee turnover.
7. GAMEPLAN provided reports showing optimum start and finish dates for each activity, although this

information was not emphasized.

8. GAMEPLAN allowed management to simulate alternative strategies and thereby revise their plan in the best way to suit the changed circumstances. When a bottleneck was noticed, the network could be changed several ways, the effects determined, and the best alternative chosen.
9. GAMEPLAN provided information related to where to seek alternatives. It provided calculations of slack, that is the excess time available related to the earliest and latest an activity could start and still finish on schedule, thereby pointing out where resources could be reallocated.
10. GAMEPLAN provided the capability for progress reports. The existence of the reports, containing the user's own commitment to perform activities, aided the issuance of orders.
11. GAMEPLAN hastened overall planning by providing a pattern for planning similar activities.
12. GAMEPLAN aided the training of new personnel by providing a logical and detailed picture of the project.
13. GAMEPLAN provided inexpensive but comprehensive storage and retrieval for the 5000 activities involved.

The objective of the Commonwealth Games Foundation was to stage the 1978 Games in a highly efficient and effective manner and at the least cost to the taxpayer. The prospect of achieving this objective without the aid of a planning

and control system is doubtful. However, it must be realized that GAMEPLAN was only one essential ingredient. GAMEPLAN was merely the management tool, and could not make management decisions or advise management. It could merely provide assistance by helping to organize management's plans in a formal way, and by reporting back that information in the format management had prescribed. GAMEPLAN merely assisted management in the planning and control process. Indications are that GAMEPLAN has proved useful and is expected to live up to everyone's expectations. Since the Games are almost a year away it is too early to decide how successful GAMEPLAN will ultimately be.

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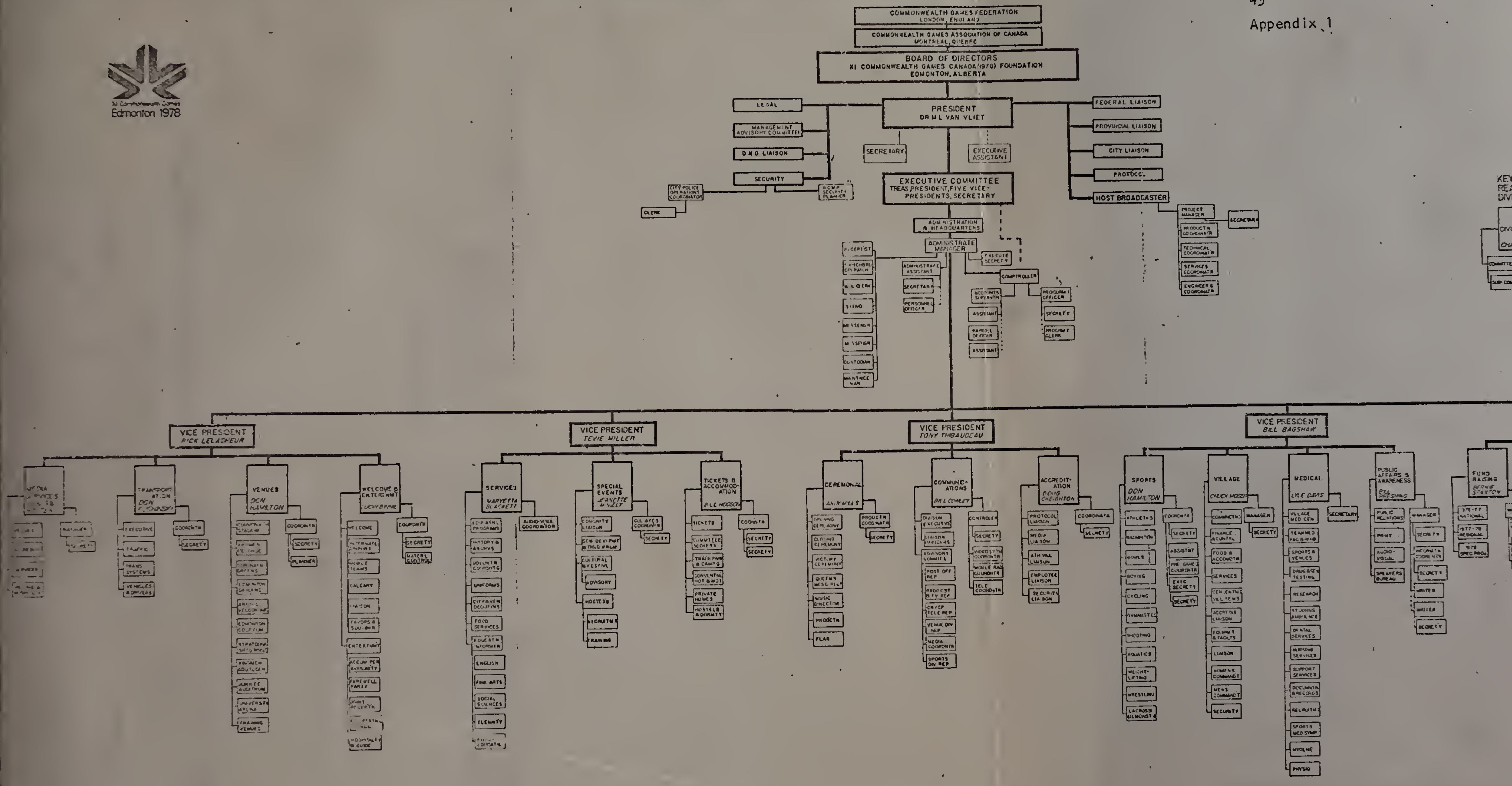
Appendix 1

XI Commonwealth Games
Edmonton 1978



```
PROJECT: TICKETS ACCOMODATION                PRINTED 11/29/77 AT 10.17.03
---------

TIMENOW DATE USED:  11/29/77

SORTED BY ACTIVITIES THAT SHOULD BE COMPLETED BY TODAY

PRED  SUCC      DUR     ES         EF        LS        LF        SLACK   SCHD      DESCRIPTION
----  ----      ---     --         --        --        --        -----   ----      -----------

I115  I120    40.00 06/15/77   08/12/77  03/04/77  04/29/77    -73.00 04/01/78   12 CAMPING AREAS AVAILABLE
I120  IB1     10.00 04/01/78   04/17/78  04/29/77  05/15/77   -232.00 05/15/78   12 PRE CAMPING BROCHURE INFO
```

```
PROJECT: TICKETS ACCOMODATION                PRINTED 11/29/77 AT 10.17.48
---------

TIMENOW DATE USED:  11/29/77

ACTIVITIES TO FALL DUE IN NEXT 30 DAYS

PRED  SUCC      DUR     ES         EF        LS        LF        SLACK   SCHD      DESCRIPTION
----  ----      ---     --         --        --        --        -----   ----      -----------

I155  I170    20.00 11/01/77   11/30/77  11/07/77  12/06/77      4.00 12/01/77   12 MONITOR NOV/77
I190  I185     5.00 12/01/77   12/08/77  12/29/77  01/06/78     18.00 01/02/78   12 DIV ACCOMO REQ
I195  I185     5.00 12/01/77   12/08/77  12/29/77  01/06/78     18.00 01/02/78   12 UPDATE ACCOMO
I365  I370    20.00 11/16/77   12/14/77  11/30/77  01/01/78     10.00 01/01/78   12 ISSUE TICKET AND ENVELOP CONTRACT
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